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Informal STEM Learning: COVID Craft Edition

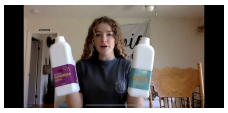
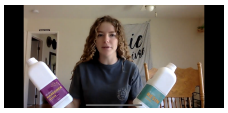
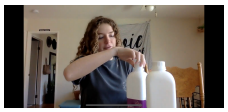
Close your eyes and reminisce on your earliest memories of science education. What do you remember? Is it the chapter seven exam in second grade about the different types of clouds, or is it the outdoor experience you had looking up and labeling the clouds as they passed by? Was it the homework assignment in fourth grade labeling the process of photosynthesis, or was it the real life experience of watching a plant sprout and grow? Considering my own early education, my first memory of science learning arises as an informal learning experience. I remember walking along the edge of my elementary school campus, looking at the visible erosion in the dirt after a rainy day. I remember going home and showing my parents that same concept of erosion in our yard. As said in *The Organization of Informal Learning,* "Often, informal learning has been defined simply as learning that occurs outside of schools. However, we believe that how learning is organized and supported is more important than where learning occurs" (Rogoff et al, 358). Walking along the edge of my elementary school campus, looking for direct effects of nature would typically be considered informal learning. Although the learning experience took place on school grounds, the organization of using the earth as a classroom, rather than the desks and white board inside the classroom, is an example of an informally supported learning procedure. Both informal and formal STEM learning practices are tremendously important to the development of students as lifelong STEM learners, however, I argue that the informal practices are the learning experiences that are more impactful.

Fast forward to today, consider any possible ways STEM has been used throughout your normal daily routine. At a first thought, I decided I do not use STEM in my daily life. I work, study for school, craft, water my plants, and cook. Seems simple enough, right? However, throughout my journey within this class, I was able to learn about all the different ways informal learning can be applied to our daily lives. I had never considered that the measurements for each drink I make as a barista, or the mixing of ingredients that I use while cooking could be considered informal STEM education. "The character of STEM education itself has been evolving from a set of overlapping disciplines into a more integrated and interdisciplinary approach to learning and skill development. This new approach includes the teaching of academic concepts through real-world applications and combines formal and informal learning in schools, the community, and the workplace" (Committee on STEM Education, v). As described in the *New Strategy for STEM Education* developed by the Committee on STEM Education, informal STEM learning should be directly connected to formal STEM learning. Understanding that the concepts taught in a textbook are routinely applied to our work, home, and personal lives is an important aspect of informal STEM education. Once I took a step back and considered what my daily routine would look like without STEM, I realized one of my hobbies would become unobtainable- crafting! During early quarantine, I developed a hobby for crafting with epoxy resin. Epoxy resin is a chemical substance that comes in two separate bottles, which actively appears after curing. Curing is the name of a chemical process where the material hardens after exposure to air, heat, or chemical additives. Epoxy resins are used when manufacturing plastics, paints, primers and sealers, flooring and other construction materials. In other words, epoxy resin is pretty hard core. I first learned about resin while considering all my options for how to seal the coolers I painted in the beginning of quarantine. Then, once I learned

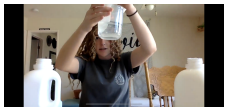
about the chemicals, I decided to try creating something out of resin. After pouring the evenly measured resin and letting the product cure for twenty four hours, I had my first finished resin project. One tray later and I fell in love with the material. I consider the process of self-taught education to be a form of informal learning. Sitting in bed, glasses on, laptop out, falling down a rabbit hole of article after article, learning as much new information as possible. I informally educated myself to a deep extent about a world of epoxy resin lovers, users, and educators. "Experiences in informal environments for science learning are typically characterized as learner-motivated, guided by learner interests, voluntary, personal, ongoing, contextually relevant, collaborative, nonlinear, and open ended" (Bell et al, 11). If informal learning was normalized and encouraged in the formal education setting, more students would experience the learner-motivated educational experiences that come from informal STEM learning.

Informal STEM education is arguably equal or more important than formal STEM education. I have memories that will last a lifetime based on learning about STEM, however, not a single one of those memories stems from a formal educational setting. From scuba diving, to crafting, to becoming a plant mom- I have countless experiences where I learned new information about the Earth, how it functions, and the progress of science and technology amongst humans on this planet. This past week, I made a set of dominoes. Yes, like the little rectangles with different amounts of dots on them. It may seem random at the moment, but as I said earlier, I recently discovered my passion for creating things with epoxy resin and I developed an Etsy shop where I sell things that I create online. My mom sent me a mold to create a set of dominoes, and said I should try it out and see if it's something I would enjoy doing. Spoiler alert, I enjoyed it a lot. One of the first but most vital steps to creating anything with epoxy resin is measuring out equal parts of the hardener and the resin. Something the average joe

would not know is that measuring out these equal parts will be based on exact measurements, not weight. It is extremely important that when you measure out 100 ml of the resin, you measure out an equal 100ml of the hardener.

1	Alexis	0:35	So first we are going to pour equal parts of our resin and our hardener, they both are like.. Okay so you buy them, epoxy resin together, but epoxy resin is active when it is mixed together. I'll explain it more while it's setting. *Holding up bottles*	
2	Alexis	0:38	But for now, we're going to take our measuring cup, and we're going to pour 100 milliliters of it. doesn't matter what order one of each, so we're gonna do the hardener first. *Looking at bottles*	
3	Alexis	0:40	And I also like to add in glitter just for fun!	
4	Alexis	0:48	*Opening cap* I am going to open and pour the hardener first.	

My transcript above begins with an explanation of measuring out equal parts of hardener and resin. This is something I learned on the internet, but I also learned through trial and error. My second batch of dominoes, I had some leftover resin mixture from the batch before, and I did not rinse the measuring cup out. I got more comfortable and more sloppy with my measurements, and my second batch of dominoes did not harden all the way. One of my sets of dominoes is completely solid, and the other set is bendy and rubbery. This experience is a prime example as to how important informal STEM learning is. Not only did I have an experience with mixing chemicals and making exact measurements, but I was able to learn from my mistakes and experience how chemicals can react to not being properly measured and mixed.

11	Alexis	1:12	It's interesting because they're two different consistencies. *pouring resin*	
12	Alexis	1:25	So it feels like you're pouring a lot more of the resin than the hardener. Which is why you have to pour measuring Ml and not weight. *Finishes pouring resin*	
13	Alexis	1:47	Now we are going to mix this together for about three to five minutes. And while it's mixing, it feels very separated. *Mixing resin in measuring cup with mixing tool*	

When I began to explain the weight difference between the two substances (turn 12), I was actively experiencing the most problematic part of pouring resin. This is the step that made my second batch of dominoes come out bendy instead of fully solid. When you pour the two parts of epoxy resin, the parts being poured together need to be equal measurements. Without having an in-depth understanding of what this means, one could assume what would make two parts equal- weight, volume, spoonfuls, eyeballing the measurements. Informal STEM education taught me via the internet, and trial and error, that equal parts for epoxy resin means exact measurements using a beaker or measuring cup to make sure the ml of each are even. If you pour 10 ml of one, 10 ml of the other must be added to that. One of the parts took longer to pour and felt heavier. This is because the consistencies of the resin and the hardener were not the same. These observations are only a few of the many things I learned through my experience with informal STEM learning during this project.

Informal learning gives us the opportunity to discover new knowledge and share unique learning processes through any everyday experience. As said in *Learning Science in Informal Environments,* “Virtually all people participate in spontaneous everyday science learning” (Bell

et al, 94). Informal STEM education is a concept I would have never thought applies to my routine, quarantine lifestyle. However, due to the lifelong learning abilities I have developed and the accessibility each and every person has to informal STEM learning, I have discovered I am constantly surrounded by new opportunities to engage in informal education. While combining my background of formal STEM education and my resources to continue informally learning, I have been able to develop new hobbies. Through my personal interest in DIY projects, I was able to learn new information through informal STEM education about chemical reactions, curing processes, and proper measurements. I have developed a curiosity for what possibilities our future holds if we begin to educate students about informal STEM learning, and how to connect informal learning to formal education. Ultimately, I believe that informal STEM learning is vital to the development of life-long learners, and is equally as important as formal STEM learning.

Works Cited

1. Bell et al, Philip. *Learning Science in Informal Environments: People, Places, and Pursuits*. National Academies Press, 2009.

2. Committee on STEM Education of the National Science & Technology Council. “Charting a Course for Success: America's Strategy For STEM Education.” Dec. 2018.

3. Rogoff, Barbra, et al. “Chapter 11 The Organization of Informal Learning.” *Review Research in Education*, vol. 40, AERA, 2016.